Chapter 3:
Patterns, Relations, Equations and Predictions

- Describing Patterns
- Solving Equations (algebra)
- $y = mx + b$

Oct 12-1:55 PM

Section 3.1 - Describing Patterns

Curriculum Outcomes	Related Activities	Page in Text
• express problems in terms of equations and vice versa • model real-world phenomena with linear, quadratic, exponential, and power equations • gather data, plot the data using appropriate scales, and demonstrate an understanding of independent and dependent variables and domain and range • construct and analyze tables relating two variables • develop and apply strategies for solving problems • describe real-world relationships depicted by graphs and tables of values • identify, generalize, and apply patterns • solve problems using graphing technology • determine if a graph is linear by plotting points in a given situation	• investigations on gathering data about visible faces on cube "trains" • a Focus on graphing data and using data to make predictions • develop an equation in the form $ax + b = c$ • demonstrate and apply an understanding of discrete and continuous number systems	96 97 98 101

Oct 12-1:51 PM

THE NUMBER SYSTEM

W =	Whole Numbers	I =	Integers
$\bar{Q}$ =	Irrational Numbers	R =	Real Numbers
N =	Natural Numbers	Q =	Rational Numbers

EXAMPLES:

W: 0, 1, 2, 3.....

$\bar{Q}$: π (3.141592...), $\sqrt{3}$, 1.23456738... , $\sqrt{15}$, ...

N: 1, 2, 3.....

I: .....-3, -2, -1, 0, 1, 2, 3, ...

R: $-\frac{1}{2}$, $\sqrt{15}$, 0 , -3 , 3 , π (3.141592) , ...

Q: $\frac{1}{2}$, $-\frac{1}{2}$, $\frac{11}{3}$, 0.2 , -0.2 , 3 , -3 , 0 , ...

Apr 28-9:05 AM

- Definitions

- Real numbers (R): ALL numbers; rational & irrational
- Irrational numbers ($\bar{Q}$):
  - they cannot be written as a fraction
  - non-repeating decimal
  - non-terminating decimal
  - Examples: 0.2163875943.... and π
- Rational numbers (Q):
  - a number that can be written as a fraction
  - Any number that is not an irrational number
  - Examples: -2.34, $3.\overline{456}$, 6.323 232 32...

Sep 3-6:11 PM

Definitions continued...

- Integers (I):
  - Positive and negative whole numbers
  - NO decimals
  - Examples: -400, +8, 0, 29, -49578
- Whole numbers (W):
  - all of the positive integers and zero
  - Examples: 0, 1, 2, 3, 4, etc.
  - NO decimals
- Natural numbers (N):
  - all of the positive integers
  - DOES NOT include zero (only difference from whole numbers)
  - Examples: 1, 2, 3, 4, etc.

Sep 3-6:49 PM

Using the previous definitions, determine if the following statements are sometimes true, always true, or never true. Justify your choices.

A) All whole numbers are integers

B) All integers are whole numbers

C) If a number is an integer then it is also a rational number.

D) If a number is a rational number then it is also an integer.

E) There is a number which is both rational and irrational.

Sep 3-6:54 PM

Copy and complete the table:

For each of the following numbers in the table, put an "x" in each category that the number belongs to. It may only belong in one, but could also belong to 5 out of the 6 categories. The first one is done for you.

Number	Real	Rational	Irrational	Whole	Natural	Integer
3.2	x	x				
0						
5.66						
-7						
15						
20009						
4.569...						
3.14...						
-3.22						
4/5						
14/2						
-6/3						
5/2						
-4.567...						
-23						
10						

Sep 3-6:59 PM

Please double check your answers to make sure that you marked the appropriate boxes.

Number	Real	Rational	Irrational	Whole	Natural	Integer
3.2	X	X				
0	X	X		X		X
5.66	X	X				
-7	X	X				X
15	X	X		X	X	X
20009	X	X		X	X	X
4.569...	X		X			
3.14...	X		X			
-3.22	X	X				
4/5	X	X				
14/2	X	X		X	X	X
-6/3	X	X				X
5/2	X	X				
-4.567...	X		X			
-23	X	X				X
10	X	X		X	X	X

Sep 3-7:25 PM

Set Notation:

- We need to know what these signs mean?

such that --> $|$

less than --> $<$

greater than --> $>$

less than or equal to --> $\leq$

greater than or equal to --> $\geq$

belongs to --> $\in$

- We need to know what number type we are dealing with?

Natural Number = N

Whole Numbers = W

Integer = I

Rational Numbers = Q

Irrational Numbers = $\overline{Q}$

Real Numbers = R

- Example:

$$\{ x \,/\, x \leq 5, x \in I \}$$

What if we were to graph this on a number line?

Ask Yourself:

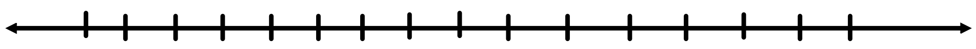
- What set of numbers am I dealing with?
- What is the sign?: am I going right or left?
- Dots or a line?:

Dots	Lines
Integers	Real
Natural	Irrational
Whole	Rational

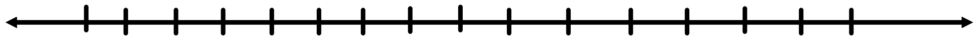
- Solid or open dots?:

Solid	Open
- most of the time	- Only use with real numbers

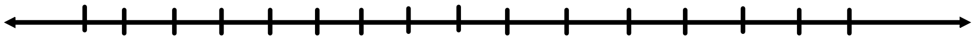
$$\{ x \,/\, x \leq 5, x \in I \}$$



Example #2: $\{ x \,/\, x > 3, x \in R \}$



Example #3: $\{ x \,/\, x < 2, x \in W \}$



Class work / Homework:

Copy and Complete the following:

Section 3.1 - "Graphing Number Lines"

1. What set of numbers do the following represent?

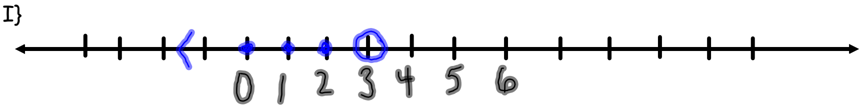
a) N b) Q c) Q d) R e) W f) I

2. Graph the following on a number line. Use a ruler to draw the line.

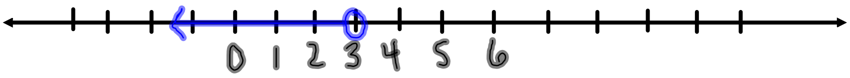
a) $\{x / x < 3, x \in I\}$ b) $\{x / x < 3, x \in R\}$ c) $\{x / x \geq 2, x \in N\}$
d) $\{x / x \geq 2, x \in I\}$ e) $\{x / x < -3, x \in R\}$ f) $\{x / x < -3, x \in I\}$
g) $\{x / x < 4, x \in W\}$ h) $\{x / x \geq 0, x \in R\}$ i) $\{x / 0 < x, x \in I\}$
j) $\{x / 0 < x, x \in R\}$ k) $\{x / 9 > x, x \in R\}$ l) $\{x / 9 > x, x \in N\}$

Answers:

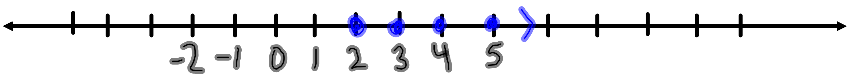
a) {x / x < 3, x ε I}



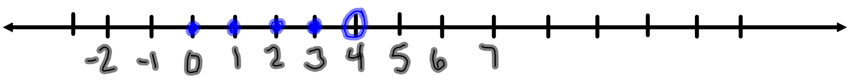
b) {x / x < 3, x ε R}



c) {x / x ≥ 2, x ε N}



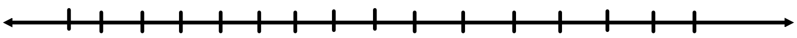
g) {x / x < 4, x ε W}



No arrow and
no dots on the negatives
because whole numbers
are not negative.

Oct 13-2:44 PM

a) {x / x < 3, x ε I}	b) {x / x < 3, x ε R}	c) {x / x ≥ 2, x ε N}
d) {x / x ≥ 2, x ε I}	e) {x / x < -3, x ε R}	f) {x / x < -3, x ε I}
g) {x / x < 4, x ε W}	h) {x / x ≥ 0, x ε R}	i) {x / 0 < x, x ε I}
j) {x / 0 < x, x ε R}	k) {x / 9 > x, x ε R}	l) {x / 9 > x, x ε N}



Oct 16-8:44 AM

State what type of number system each of the following sets of numbers would fall under:

a) {-2, -1, 0, 3, 5, 7}
b) {-4.5, -2, -0.5, 0, 0.5, 6}
c) {0, 2, 4, 6, 8}
d) {2, 4, 6, 8, 10, 12}
e) {1/2, 1/4, 0.75}
f) {π, √2 , 5.482957271615303846202784}

Oct 16-8:43 AM

Warm Up:

1. State what type of number system each of the following sets o numbers would fall under:

a) {-2, -1, 0, 3, 5, 7}
b) {-4.5, -2, -0.5, 0, 0.5, 6}
c) {0, 2, 4, 6, 8}
d) {2, 4, 6, 8, 10, 12}
e) {1/2, 1/4, 0.75}
f) {π, √2 , 5.482957271615303846202784}

2. Graph the following on a number line:

a) $\{x \ / \ x \leq 5, x \in I\}$ b) $\{x \ / \ x < 2, x \in W\}$

c) $\{x \ / \ x \leq 3, x \in N\}$ d) $\{x \ / \ x < 2, x \in N\}$

Oct 13-9:27 PM

Modeling:

- a technique of producing a mathematical description or model that can be used to solve a practical problem
- modeling can be done through the use of:

1. Equations

   Example: $y = 2x$

2. Table of values

   Example:

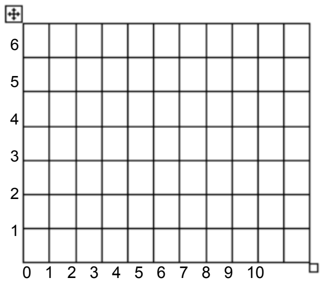
x	y

3. Ordered Pairs

   Example: (0, 0) (1, 2) (2, 4) (3, 6)

4. Graphing

   Example:



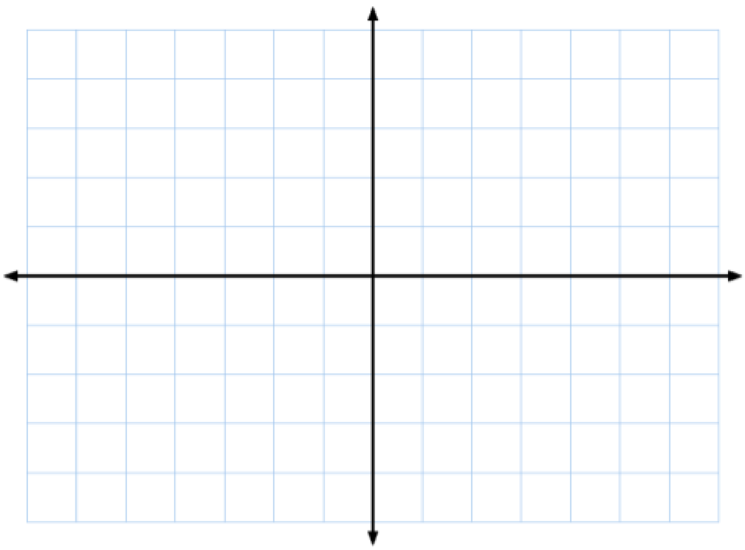
Graphing Review:

Graph the following: $y = 2x - 1$ $\qquad x,y \in R$

1. Table of Values:

x	y
-2	
-1	
0	
1	
2	

2. Graph the co-ordinates:



Domain & Range:

<u>Domain</u> - set of all possible x values

<u>Range</u> - set of all possible y values

- When writing domain and range in set notation they should be written in order of smallest to largest. Numbers should not be repeated.

What is the domain for the following ordered pairs? What is the range?

(2,1) (3,4) (5,6) (8,9) (10,11)

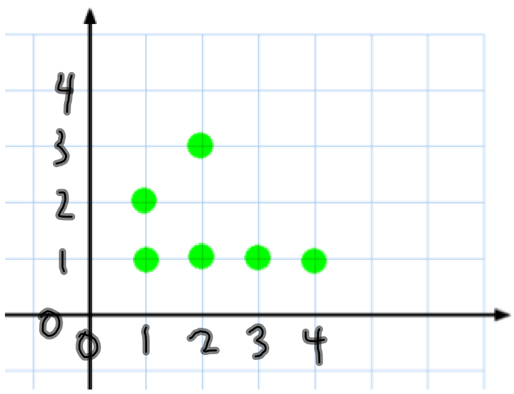
Domain =

Range =

Oct 13-1:48 PM

What is the domain for the following graph? What is the range?

(x,y) → always this order.



- least to greatest
- can't repeat #'s

Domain =

Range =

Oct 13-2:06 PM

Discrete & Continuous:

Discrete Data

- finite number of values in between 2 points
- every number is **not** possible
- easily "countable"
- dots on a graph

Examples:

- Number of books on a shelf
- Number of defective items in a shipment of 50 pens

Continuous Data

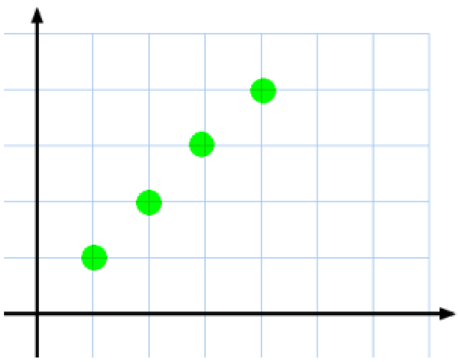
- infinite number of values in between 2 points
- every number **is** possible
- dots are joined

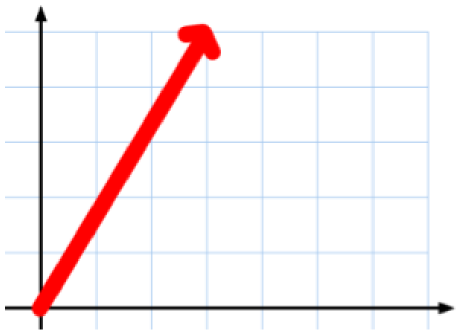
Examples:

- 1-5 and everything in between
- timing for a 100 m dash

Oct 13-2:18 PM

Is this a graph of Discrete or Continuous Data?





Oct 13-2:23 PM

Practice:

1. What is the domain & range of the following set of ordered pairs?

(2,1) (3,2) (8,9) (3,10) (1,3) (3,6) (2,10)

2. Are the following situations discrete or continuous?

a) The height of trees at a nursery over a period of 20 years
b) The number of correct answers on a student's multiple choice quiz
c) How many times it would take a person to pass their driver's test
d) The length of time it takes for a light bulb to burn out

Oct 13-2:25 PM

Class work / Homework:

Complete worksheet:

"Section 3.1 - Domain & Range, Discrete & Continuous"

Domain, Range, Continuous & Discrete worksheet #2.doc

Oct 13-2:39 PM

Questions:

1. List the domain and range in set notation for each of the following sets of ordered pairs.

a) {(2,1) , (-1, 3) , (4, 2) , (3,-2)}

b) {(0,2) , (-1,-1) , (3,2) , (2,3)}

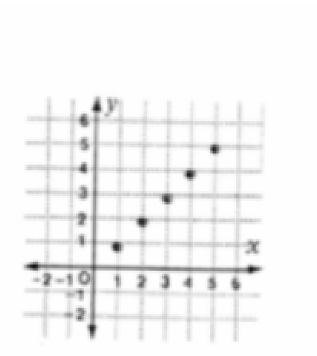
2. List the domain and range in set notation for the table of values.

X	3	3	4	5	3	4	5	4	5	5
Y	1	1	1	1	2	2	2	3	3	4

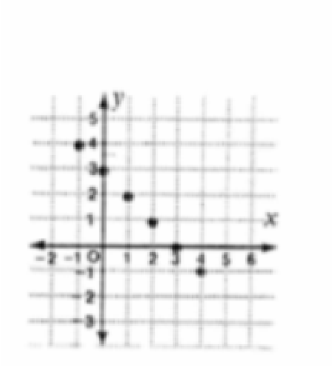
Oct 13-3:01 PM

3. List the domain and range in set notation for each of the following graphs.

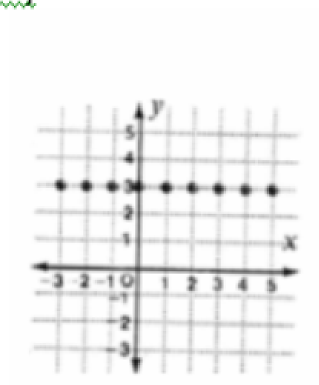
a)



b)



c)



4. Graph the following equations by creating a table of values.
Determine if the data is either discrete or continuous.

a) $x + y = 4$ $\quad x, y \in N$

b) $x + y = 3$ $\quad x, y \in I$

c) $x + y = 2$ $\quad x, y \in R$

d) $x - y = 2$ $\quad x, y \in R$

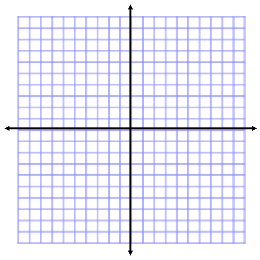
Oct 16-9:57 AM

Example 1: Make a table of values and graph

$y = 4x - 5$ $\quad x,y \in I$ "x" values must be:

x	y=4x - 5	y

Coordinates:



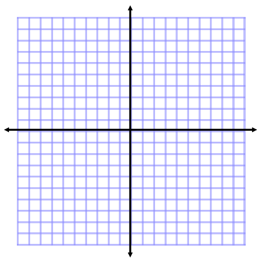
Example 2: $x - y = 5$ $\quad x,y \in W$

- You need to rearrange this so that it is y= __

$x - y = 5$

x	y

Coordinates:



Class work / Homework:

For each of the following make a table of values and graph the coordinates. Copy these down.

(1) $y = -2x - 1$ $\qquad x,y \in I$

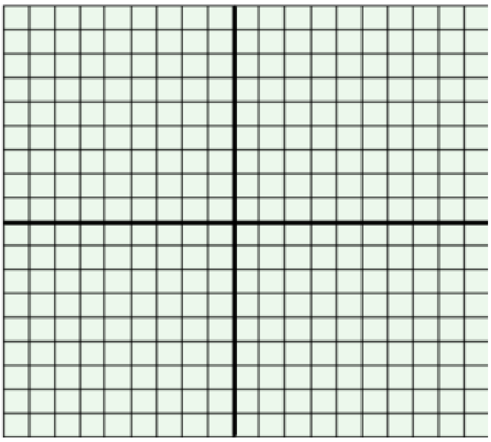
(2) $y = 3x + 2$ $\qquad x,y \in W$

(3) $y = -1x - 2$ $\qquad x,y \in N$

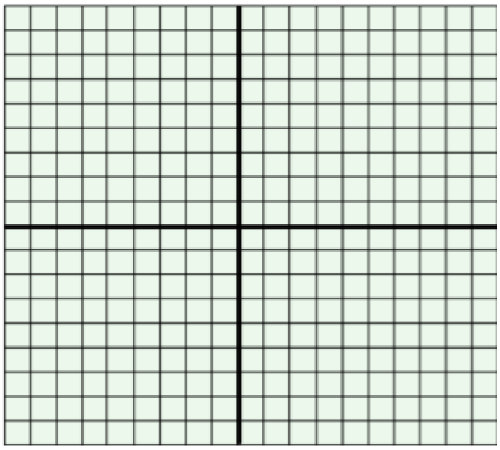
(4) $x + y = -2$ $\qquad x,y \in R$

3. **Graph the following equations. Determine if the data is either discrete or continuous.**

$y = 2x + 3 \quad x, y \in I$



$y + 5x = 7 \quad x, y \in R$



d r

= 7 + 10 = 17

Oct 14-5:21 PM

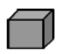
Investigation #1:

Finding a Pattern: we will use a pattern to make predictions about trains constructed from cubes.

Together As a Class.........

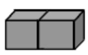
A. Place one cube on the desk. How many faces are visible?

1 CUBE



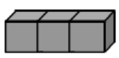
B. Use two cubes to make a train on the desk. How many faces are visible?

2 CUBES



C. Create more trains. Each train will have one cube more than the previous train. Record the number of visible faces on each train.

3 CUBES



Number of Cubes	1	2	3	4	5	6	7
Number of Visible Faces	5						

What pattern do you see in the sequence of numbers you collected?

sequence = a set of numbers arranged in order according to a pattern or rule.

Oct 13-7:31 PM

Investigation Questions:

1. How many visible faces are there for a train of 11 cubes?

2. What is the number of visible faces for a train of 12 cubes and for a train of 15 cubes?

3. List restrictions on possible values for the number of visible cubes.

4. Predict the number of visible faces for a train of 200 cubes.

Oct 13-8:17 PM

Class work / Homework:

Complete the following:

- Focus A - A, B, C (write the set notation for the domain and range), and D

- Focus Questions 5, 6, 7, 8 a, and 9

- Check your Understanding 13, 14, 16

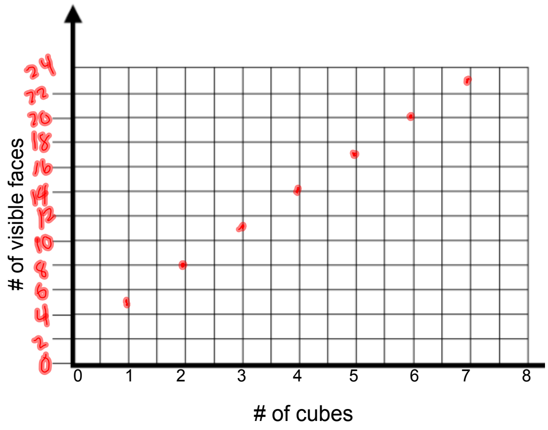
Oct 13-8:33 PM

Answers:

- Focus A:

A. On Cartesian plane, graph the table of values from Investigation #1:

Number of Cubes	1	2	3	4	5	6	7
Number of Visible Faces	5	8	11	14	17	20	23



B. Should you join the points on the graph (determine whether the data are continuous or discrete)? No

Because ① you count the # of faces, not measure.
② you will never have decimal answers

Oct 13-8:17 PM

C. Write the set notation for domain and for the range.

domain (x-values) {c | c = 1,2,3,4,5,6,7, c ∈ W}

range (y-values) {f | f = 5,8,11,14,17,20,23, f ∈ W}

D. Describe the patterns shown on the graph:

a) geometric pattern Linear
(makes a straight line)

b) display of patterns from the table of values
You should notice that the data goes up by 3 in the table of values. Also, the graph changes by a rate of 3. (This would be slope)

rise
run

c) why are all the points in the first quadrant

2	1
3	4

They are all in the first quadrant because they are all positive.

Oct 14-7:17 PM

- Focus Questions:

5. a) Use your graph to find the number of visible faces for a train with 18 cubes.

b) Explain how you found your answer. Is a graph teh best way to do this? Explain.

c) How confident are you that your answer is correct?

6. What is the most reasonable way to find the number of visible faces for a train of 200 cubes? Explain.

Between a graph and table of values, the graph would be most reasonable → easy to extend line

7. Is it easier to use a graph or a table of values to make predictions for a large number of cubes? Explain.

Graph

however, an equation would be easiest. (just substitute the value)

Oct 13-8:32 PM

8. Suppose you were asked to find the number of visible faces for a train with 1000 cubes.

a) Explain why it would not be practical to use a cube model, table of values, or graph to find the number of visible faces.

9. Look at the pattern in the trains. Find the number of visible faces for each of the following trains.

a) 22 cubes b) 30 cubes c) 40 cubes

d) 50 cubes e) 60 cubes f) 70 cubes

Oct 13-8:16 PM

Creating Equations Terminology:

- Sum Add
- Product Mult.
- Difference Subt.
- Plus Add.
- Doubled Mult. by 2
- The result is equals
- Is the same as equals
- Tripled Mult. by 3
- Diminished by subtract
- Quotient Divide
- Decreased by Subtract
- Take a half
- Trebled

Oct 19-3:26 PM

Creating Equations Examples:

a) a number increased by 8.

$n+8$

b) John's age 3 years from now.

$J+3$

c) Three times the volume decreased by 10.

$3v-10$

d) The value, in cents, of x nickels.

$5x$

e) One-half of the age Susan was 2 years ago.

$\frac{S-2}{2}$ or $(S-2)\div 2$

Oct 19-3:28 PM

Creating Equations:

1. Three times a number. $3n$
2. A number increased by 4. $n+4$
3. A number decreased by 3. $n-3$
4. The length increased by 5m. $L+5$
5. Mary's age 2 years ago. $m-2$
6. John's age 5 years from now. $j+5$
7. Twice the width increased by 3. $2w+3$
8. One-half the speed. $s \div 2$
9. Eight points less than the winner. $w-8$
10. Three times the volume decreased by 20. $3v-20$
11. The value, in cents, of x quarters. $25x$
12. One third of Tom's age 10 years from now. $(T+10)\div 3$
13. Six times a number decreased by 2. $6n-2$
14. Four times as many people. $4p$
15. Twice a number decreased by 7 equals 41. $2n-7=41$
16. 19 is subtracted from 3 times a number and the result is -1.
17. When a number is multiplied by 7, and 35 is subtracted from the product, the result is 59.

16 $3n-19=-1$ 17 $7n-35=59$

Oct 19-3:21 PM

Attachments

Domain, Range, Continuous & Discrete worksheet #2.doc